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Center of Gravity Method for Finding Center of Laser Beam Projection on Landslide Measurement

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***Abstract*—Landslides have caused many casualties and property. High rainfall is a major cause of soil slip. Landslides will usually be preceded by creeping soil movements. Several types of ground motion detectors including inclinometers have been used to detect this state. Proposed method is using laser beam and camera as detector of landslide. As for the benefits for science is the development of monitoring methods using laser light which is very rare or even done so far. Signals in the form of laser beam projection images captured from the camera are sent using the internet network. The image will be processed so that it can be compared with images taken previously. Changes in laser point indicate ground shift. The accuracy of determining the point of the laser beam that spreads when it is received on the target board is corrected using the cluster center method. In addition, the placement of the control plate will make the direction of the laser beam always towards the target plate. The results of the study have concluded that this system can work well and accurately.**

Keywords—laser, cluster, acquisition, plate, detector

I. INTRODUCTION

For developing countries, the problem of disaster is one of the obstacles in improving the quality of human resources, given that growth should not be impeded. several types of disasters have made people move from one place to another. less popular disaster but has quite a lot of events is the movement of land that causes landslides. in the tropics, the landslide disaster is ranked third. the physical magnitude of the cause of the landslide can be scientifically measured and can be well predicted. Land shifting occurs a lot and is a complex event and depends on many factors which are sometimes difficult to predict beforehand. It is necessary to breakthrough technologies so that disaster prevention can be improved. With the use of information and communication technology that is efficient and efficient a reliable and efficient system can be obtained. The limited amount of power can be overcome with a simple but efficient telemetry model. An example is using a power on Ethernet system to power an equipment. We need equipment to read soil conditions to be sent to data centers in different places, so that the analysis can be done without having to monitor every period at the ground movement location. in measuring ground motion, the instrument inclinometer is one of the tools often used to measure ground motion and the results are considered accurate. its small dimensions, high sensitivity and accuracy, low power supply, and low cost are the main reasons for using this equipment [1]. But the actual inclinometer can only detect the slope of the land, but it cannot accurately measure the amount of ground shift, in this case horizontal shift. In areas where the land is moving, what is needed is not only the change in the slope of the land, but the value of the shift to the starting point cannot be detected. Then it is necessary to measure or relevant equipment to measure the amount of land movement in a certain period of time in the horizontal direction. Data about ground movement conditions that can be sent to the monitoring center are signals from translation positions that can be read from sensors mounted near the target plate. The shift signal captured by the sensor can be stored and sent periodically or continuously, according to the required period, or the speed of the ground crawl. The disaster telemetry system with the proposed model is very necessary which can be made at a low cost. The purpose of this research is to produce a telemetry system to monitor ground shifts at low speeds with high quality, but high quality middle-aged soil. in addition, to obtain sensor design methods and telemetry systems for the purpose of monitoring land shifts that are slow moving. The effect is quite significant for the community is in the form of information about the condition of the land that moves, so they can anticipate in advance. It is expected that the output of this research activity is to obtain a laser-based sensor system to be able to detect ground motion that is quite reliable and accurate. Signals in the form of target plate images that are exposed to laser light can be sent using the internet network, so that they can be monitored continuously or periodically. The importance of this research for science is the development of methods of applying sensors using laser light that have not been done so far. The design of a monitoring network system is more integrated on a broader scale, not only limited to areas that are narrow in scope, but can be integrated on a wider system.

II. THE MATERIAL AND METHOD

A. Laser Beam Characteristics

Gaussian rays are magnetic radiometers and transverse monochromatic radiometers the amplitude profile of the electric field is given by the Gaussian function. It reflects the intensity of the Gaussian profile. This is basic Gaussian transversal mode is the most laser output, because the beam can focus on the most concentrated space. While beams like this have refocused the lens, transverse phase dependency; this results in a different Gaussian beam. Electric and magnetic fields the amplitude profile along the Gaussian sphere beam (for certain waves and polarizations) is determined by single parameter (waist circumference). In certain positions, they are at the waist of the predetermined beam, field amplitude and phase determined.

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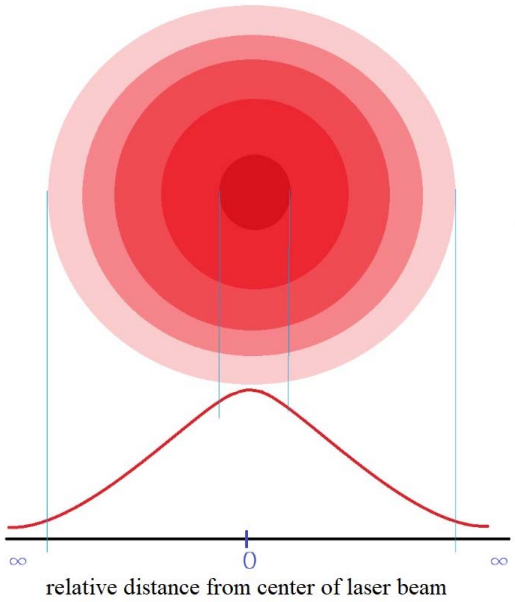

Fig. 1 Distribution of Laser Beam Intensity

The arbitrary solution of the paraxial Helmholtz equation can be said to be a combination of the Hermite-Gaussian mode. Amplitude profile can be separated by x and y using Cartesian coordinates. Anytime the point on the z-beam of this mode includes a Gaussian factor that is similar to the basic Gaussian mode. Additional geometric factors for the specified mode. But the different modes are different from Gouy. The phase in which the transversal profile is generated because the mode superposition develops in z, whereas propagation each Hermite - Gaussian mode still has the same shape along the beam. Although there are other possible capital breakdowns, this is the most useful family solution to this problem involves compact rays, that is, optical power close enough along the axis. Even when it's laser does not operate in basic Gaussian mode, power is generally found among the lowest order modes decomposition, because the higher sequence mode will surpass the laser resonator.

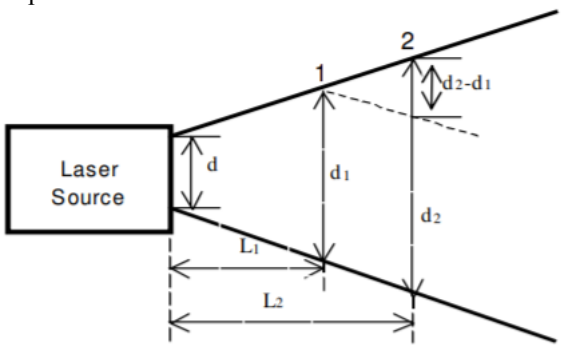

Fig. 2 Distribution of Laser Beam Intensity

The use of a laser beam is needed to obtain measurement accuracy. Therefore it is necessary to place a light transmitter that is strong enough to not change easily by changes in weather and humidity.

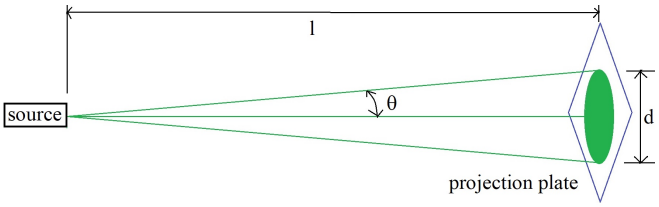

Fig. 3 Distribution of Laser Beam Intensity

l : distance between laser source and projection plate
d : diameter of projected laser beam on plate
θ : divergence angle of laser beam

B. Ground movement and Measuerments

Slope stability of a soil condition with a sloping surface needs to be done to ensure the safety of an area that has sloped ground conditions. avalanches, especially in sloped areas often arise due to limited knowledge possessed or also carried out omission of the symptoms of damage that occurs. Various ways to be able to study slope stability. Field data when analyzing slope stability is very much needed. One of the results of the field data obtained is to find out the type of soil at the location and from several test points conducted can be used to describe the profile / bedding of existing soil. One of the field data that can be done with a fairly short implementation time but the results can be accounted for is using a Geoelectric test. Geoelectric test can be done with one dimension or two dimensions. Location of the review in this study is in Bendan Duwur, Semarang city towards the Kaligarang river. This site selection consideration is to complement existing research data. Another consideration for choosing this location is to get a more complete result, bearing in mind that this road is a vital path but has repeatedly been damaged despite repairs.

Ground motion is the process when the mass of an earth's material moves by Earth's gravity either slowly or rapidly from one place to another. The ground movement occurs as a result of disturbed slope stability, because the driving force of the land which is a landslide exceeds the holding force. This can occur because of an imbalance of forces at ground level and trigger external forces acting on the slope. Strength in soil is influenced by soil type conditions; soil density; the level of shear strength of each soil parameter and underground water flow. Meanwhile the external forces that can influence the movement of the soil are the load acting on the ground, the rainwater entering the ground and the slope angle.

In general, the character of slopes is divided into two types, namely unlimited slopes and limited slopes. Slope stability can be seen from the safety figures from the slope condition analysis. The slope will be considered unstable if it has a safety factor of less than one (FK <1). Safety figures for slopes are considered stable if the safety factor is more than one (FK> 1).

C. Centre of Gravity

Clustering is a grouping of objects so that objects in the same group are more similar to each other. Laser beam that projected into target plate could be recorded with CCTV camera. Diameter of laser beam projection on target plate was around 3 centimeters. Center of laser beam projection

have to be calculated as instantaneous center. Picture file that recorded contains many pixel that representation of laser beam projection. There are many pixel with same color (green). Center of pixel group could be calculated using center cluster method. For three pixel denoted by A, B and C could be calculated their center.

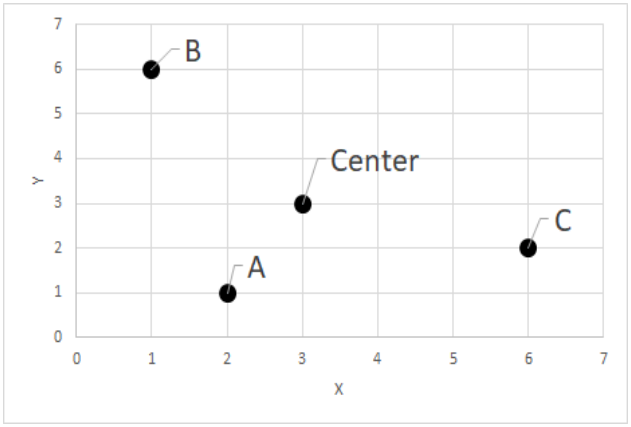

Fig. 4 Center cluster of three pixel

Cartesian coordinate of pixel A, B and C shown in table 1. Position of pixel A, B, and C distributed around center.

TABLE I
CENTRE OF THREE PIXEL FOR CENTRE CALCULATION

Pixel	X	Y
A	2	1
B	1	6
C	6	2

Position of center could be calculated as following formula :

xCenter = (xA + xB +xC)/3
yCenter = (yA + yB + yC)/3

Center of this cluster could be easily calculated, then the center coordinate is (3,3). Greater amount of pixel with green color detected could be grouped into a cluster. By using same method, center of cluster could be calculated. Clusters include groups with small distances between cluster members, dense areas of data space, intervals or certain statistical distributions. The centroid of a finite set of k is

$$C=(x1 + x2 + x3 +\ldots+xk)/k \quad (1)$$

The k-Means algorithm does clustering by putting data points into clusters whose closest center is located. The quality of the k-Means algorithm is very dependent on the selection of the initial k center points of the cluster. This method is simple and fast, but can result in loss of correlation between dimensions in the data set. The point of representation in this research algorithm was made with a density-based approach. Initially the algorithm looks for core points in the data set and then groups core points that reach density with each other into a group. Each group is represented by a representation point that is in the middle of the group. Because the representational point represents the core point and is in the middle of the core point, it is most likely that the initial center point of the cluster produced is already in the center of the cluster.

Space distance is used to calculate the distance between data and centroid. Euclidean Distance Space Spelling. Euclidean space distance is often used in distance calculation, this depends on the results obtained is the shortest distance between the two points calculated.

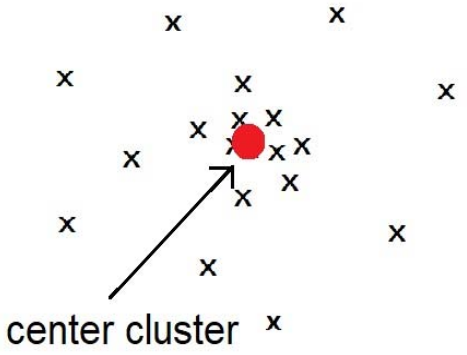

Fig. 5 Center of cluster

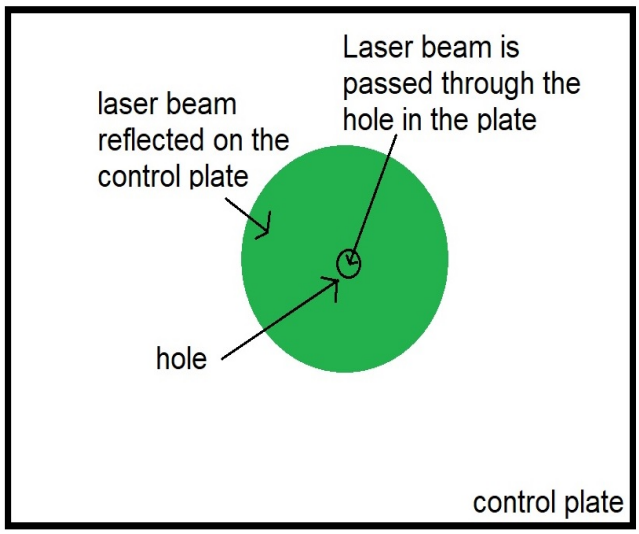

Fig. 6 Control plate for adjusting laser beam direction and reduce diffraction

III. RESULTS AND DISCUSSION

At first the laser beam is fired from a relatively stationary place, towards the target plate located in a moving area. To keep the direction of the laser beam from changing, a plate is installed between the laser and the target plate. Laser beam widening can be reduced by reducing the laser beam widening, through a filter in the form of a 5 mm diameter hole in the control plate. This beam projection is too thick for its center to be detected, due to the long distance between the laser source and the monitor metal plate.

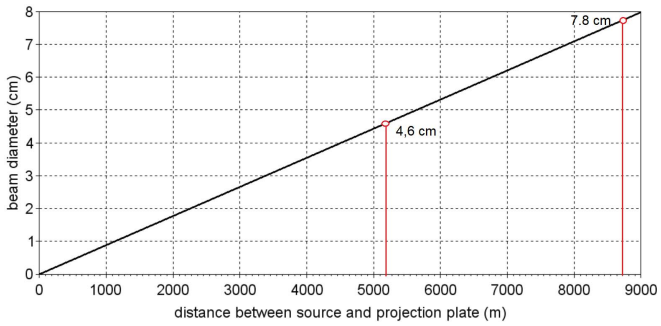

Fig. 7 Laser beam projection diameter

Diameter of laser beam projection on target plate for distance between laser source to taget palet of 8.8 meter is 7.8 cm. This beam projection is too thick for its center to be detected, due to the long distance between the laser source and the monitor metal plate.

Thickness of laser beam projection is reduced by using control plate between laser source and target plate. Control plate is installed at distance of 52 meter from laser source. Control plate is installed in stable position, on south side wall of sporthall.

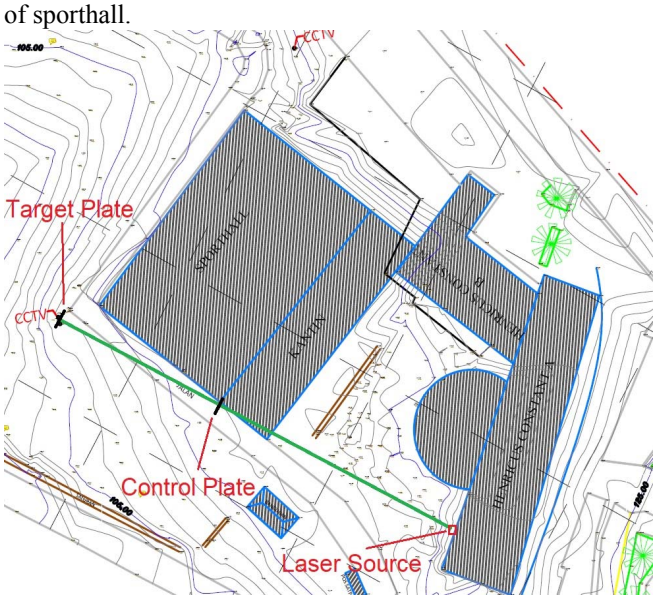

Fig. 8 Pole position for laser and sensor placement

Laser beam projection on the monitor metal board is too big to decide size of landslide per certain period. In order to obtain more precision measurement, central cluster method is applied. Based on imaging signal processing system, by using inverted signal and center cluster method, the center of beam is calculated. Center of laser beam will be change when there are any landslides on pole A. If projection of laser beam is reduced, there is need adjustment on laser source direction. It will be happen when the laser beam changes its direction because of climate or other condition.

By using signal processing calculations, the image will be reversed to get a lot of contrast from the image. But the transition between white and black areas still appears in this picture. A high pass filter is applied to a lot of contrast. The center of the projected laser beam is calculated using the cluster center method to get the exact position of Pole A. This center will change when there is a landslide at the position of Pole A. Points considered as the center of the beam will be stored and compared with the previous measurement values. So that ground movement can be monitored on a daily basis. Laser beam emitting is not carried out continuously every day, but only a few minutes a day in the same time. This is done so that not too much irrelevant data will enter the storage system.


Fig. 1. Laser beam Projected at Metal Plate

IV. Conclusion

Soil movements that can cause landslides can be detected using laser beam projections to get precise measurements. The laser beam must be projected onto the target plate which is placed in a potential landslide. The direction of the laser beam shot is very easily shifted by environmental conditions. Then one control plate with a hole needs to be placed to reduce the laser beam distribution. This plate must be installed in the place between the laser beam source and the target plate to always be able to adjust the direction of the laser beam. In addition, the hole in the plate serves to reduce the widening of the laser beam. The laser beam projected on the target plate will be processed by flipping the projected image. After that, a high pass filter is applied to get a lot of contrast. The center of the beam is calculated using the centroid method. The movement of the point obtained represents the movement of the ground.

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Disturbance Observer-Based Speed Estimator for Controlling Speed Sensorless Induction Motor

E TOP 5 A B C D E F G H I L M N O P Q R S T U V W

Effect of Android and Social Media User Growth on the Financial Technology Lending Borrowers and its Financing

Energy Management Efficiency and Stability Using Passive Filter in Standalone Photovoltaic Sudden Cloud Condition

Experimental Security Analysis for Fake eNodeB Attack on LTE Network

Extraction Dependency Based on Evolutionary Requirement Using Natural Language Processing

F TOP 5 A B C D E F G H I L M N O P Q R S T U V W

Facial Expression Recognition and Face Recognition Using a Convolutional Neural Network

Feature Selection on Magelang Duck Egg Candling Image Using Variance Threshold Method

Features of the Use of Solar Panels at Low Temperatures in the Arctic

Firefly Algorithm-based Optimization of Base Transceiver Station Placement

Fruits Classification from Image using MPEG-7 Visual Descriptors and Extreme Learning Machine

G TOP 5 A B C D E F G H I L M N O P Q R S T U V W

Gender recognition based on ear images: a comparative experimental study

Guided Genetic Algorithm to Solve University Course Timetabling with Dynamic Time Slot

H TOP 5 A B C D E F G H I L M N O P Q R S T U V W

Hybrid Method for Flower Classification in High Intra-class Variation

I TOP 5 A B C D E F G H I L M N O P Q R S T U V W

Implementation of Fuzzy-PID Based MPPT for Stand Alone 1.75 kWP PV System

Implementation of Maximum Power Point Tracking on PV System using Artificial Bee Colony Algorithm

Improving Classification Attacks in IOT Intrusion Detection System using Bayesian Hyperparameter Optimization

Indonesian Parsing using Probabilistic Context-Free Grammar (PCFG) and Viterbi-Cocke Younger Kasami (Viterbi-CYK)

Indonesian Stock Price Prediction including Covid19 Era Using Decision Tree Regression

Indonesian Traffic Sign Recognition For Advanced Driver Assistent (ADAS) Using YOLOv4

Influence Distribution Training Data on Performance Supervised Machine Learning Algorithms

Initial Access in 5G mmWave Communication using Hybrid Genetic Algorithm and Particle Swarm Optimization

Interference Mitigation in Cognitive Radio Network Based on Grey Wolf Optimizer Algorithm

L TOP 5 A B C D E F G H I L M N O P Q R S T U V W

Leveraging Side Information to Anime Recommender System using Deep learning

M TOP 5 A B C D E F G H I L M N O P Q R S T U V W

Measurement of Information Security Awareness Level: A Case Study of Online Transportation Users

Measuring Instagram Activity and Engagement Rate of Hospital: A Comparison Before and During COVID-19 Pandemic

Minimization of Power Losses through Optimal Placement and Sizing from Solar Power and Battery Energy Storage System in Distribution System

Model Development of Information Technology Value for Downstream Petroleum Industry

Modification of 2.2 GHz S-Band Rectangular Patch Microstrip Antenna using Truncated Corner Method for Satellite Applications

Modification of Wireless Reverse Charging Scheme with Bundling Optimization Issues

Multi-Point Travel Destination Recommendation System In Yogyakarta Using Hybrid Location Based Service-Floyd Warshall Method

Multilayer Secure Hardware Network Stack using FPGA

Multivariate Time Series Forecasting Based Cloud Computing For Consumer Price Index Using Deep Learning Algorithms

N TOP 5 A B C D E F G H I L M N O P Q R S T U V W

Network Attack Detection System Using Filter-based Feature Selection and SVM

O TOP 5 A B C D E F G H I L M N O P Q R S T U V W

On Parameter Estimation of Stochastic Delay Difference Equation using the Two m-delay Autoregressive Coefficients

Optimization Coagulation Process of Water Treatment Plant Using Neural Network and Internet of Things (IoT) Communication

Optimization of SV-kNNC using Silhouette Coefficient and LMKNN for Stock Price Prediction

P TOP 5 A B C D E F G H I L M N O P Q R S T U V W

Papaya Disease Detection Using Fuzzy Naïve Bayes Classifier

Particle Filter Based Speed Estimator for Speed Sensorless Control in Induction Motor

Performance Analysis FSR and DSR Routing Protocol in VANET with V2V and V2I Models

Performance Analysis of Temporally Ordered Routing Algorithm Protocol and Zone Routing Protocol On Vehicular Ad-Hoc Network in Urban Environment

Performance Comparison of Data Mining Techniques for Rain Prediction Models in Indonesia

Performance Enhancement in Macro-Femto Network Using a Modified Discrete Moth-flame Optimization Algorithm

Performance Enhancement of Multi-User Key Extraction Scheme (MKES) Based on Imperfect Signal Reciprocity

Performance Evaluation of Cell-Edge Femtocell Densely Deployed in OFDMA-Based

Macrocellular Network

Performance Evaluation of IPTV Multicast Service Testing for XGS-PON Optical Line Termination

Performance Evaluation of XGS-PON Optical Network Termination for Enterprise Customer

Personality Dimensions Classification with EEG Analysis using Support Vector Machine

Predicting User Preferences with XGBoost Learning to Rank Method

Prediction of forest fire occurrence in peatlands using machine learning approaches

Prediction of Gross Domestic Product (GDP) in Indonesia Using Deep Learning Algorithm

Prediction of Liver Cancer Based on DNA Sequence Using Ensemble Method

Prototype Design of IoT (Internet of Things)-based Load Monitoring System

Proximity-based COVID-19 Contact Tracing System Devices for Locally Problems Solution

PSO-Learned Artificial Neural Networks for Activity Recognition

Q TOP 5 A B C D E F G H I L M N O P Q R S T U V W

Quality Assessment of Digital Terrestrial Television Broadcast in Surabaya

R TOP 5 A B C D E F G H I L M N O P Q R S T U V W

Real-time Testing on Improved Data Transmission Security in the Industrial Control System

Removing Noise, Reducing dimension, and Weighting Distance to Enhance k-Nearest Neighbors for Diabetes Classification

Resource-Aware Pareto-Optimal Automated Machine Learning Platform

Risk Prediction of Major Depressive Disorder using Artificial Neural Network

Roadside Unit Power Saving using Vehicle Detection System in Vehicular Ad-hoc Network

Robust Control Design Procedure and Simulation of PRES Controller having Phase-Locked Loop (PLL) control technique in Grid-Tied Converter

Royale Heroes: A Unique RTS Game Using Deep Reinforcement Learning-based Autonomous

Movement

S TOP 5 A B C D E F G H I L M N O P Q R S T U V W

Ship Heading Control Using Nonlinear Model Predictive Control

Single Snapshot-Spatial Compressive Beamforming for Azimuth Estimation and Backscatter Reconstruction

Smart Safe Prototype Based Internet of Things (IoT) with Face and Fingerprint Recognition

Some Numerical and Analytical Solutions to an Enzyme-Substrate Reaction-Diffusion Problem

Speaker Recognition For Digital Forensic Audio Analysis Using Support Vector Machine

Speaker Recognition Using Mel Frequency Cepstral Coefficient and Self-Organising Fuzzy Logic

Speech Emotion Detection Using Mel-Frequency Cepstral Coefficient and Hidden Markov Model

Speech Gender Classification Using Bidirectional Long Short Term Memory

Stemming Javanese: Another Adaptation of the Nazief-Adriani Algorithm

Students Academic Performance Prediction with k-Nearest Neighbor and C4.5 on SMOTE-balanced data

Supervised Deep Learning for Thyroid Nodules Classification Based on Margin Characteristic

T TOP 5 A B C D E F G H I L M N O P Q R S T U V W

Techno-Economic 5G New Radio Planning at 26 GHz Frequency in Pulogadung Industrial Area

Text-Independent Speaker Identification Using PCA-SVM Model

The Best Parameter Tuning on RNN Layers for Indonesian Text Classification

The Head Posture System Based on 3 Inertial Sensors and Machine Learning Models: Offline Analyze

The Multimodal Transfer Learning for Diagnosing COVID-19 Pneumonia from Chest CT-Scan and X-Ray Images

The N-Sheet Model in Capacitated Multi-Period Cutting Stock Problem with Pattern Set-Up Cost

The Single Tuned Filter Planning to Mitigate Harmonic Pollution in Radial Distribution Network Using Particle Swarm Optimization

The Use of Pre and Post Processing to Enhance Mandible Segmentation using Active Contours on Dental Panoramic Radiography Images

The User Experience effect of Applying Floating Action Button (FAB) into Augmented Reality Anatomy Cranium Media Learning Prototype

Three Phase Induction Motor Dynamic Speed Regulation Using IP Controller

Topic-Based Tweet Clustering for Public Figures Using Ant Clustering

TwoChain: Leveraging Blockchain and Smart Contract for Two Factor Authentication

U TOP 5 A B C D E F G H I L M N O P Q R S T U V W

Unstructured Road Detection and Steering Assist Based on HSV Color Space Segmentation for Autonomous Car

V TOP 5 A B C D E F G H I L M N O P Q R S T U V W

Validation of Information Technology Value Model for Petroleum Industry

Variations in the Placement of DFIG in the Power System to Changes of Short Circuit Current

W TOP 5 A B C D E F G H I L M N O P Q R S T U V W

Website Design for Locating Tuna Fishing Spot Using Naïve Bayes and SVM Based on VMS Data on Indonesian Sea